The Chicago Center for Cosmochemistry

The Chicago Center for Cosmochemistry is dedicated to promoting education and research on the origins of elements and isotopes in the universe and the chemical composition of matter in the solar system. Composed of scientists from the Argonne National Laboratory Materials Science Division, The University of Chicago, and The Field Museum, the center takes advantage of the strength of the cosmochemistry community in Chicago and the superb research facilities available at the three institutions involved. It provides support for graduate students, postdoctoral research associates and visiting scientists. The ANL Materials Science Division's unique analytical expertise is a significant factor in realizing the benefits of this highly interdisciplinary enterprise.

Major projects underway include: (1) the analysis of meteoritic stardust grains, which coupled with nucleosynthesis theory probes stellar processes and the origins of the elements; (2) isotopic and chemical studies of meteorites and rocks to probe the early history of the solar system, planet formation and early Earth history; (3) studies of the Sun, planets, asteroids and comets through NASA sample return missions such as Genesis and Stardust, and spaceflight instruments.

Research facilities include the unique CHARISMA and SARISA instruments at Argonne, resonant ionization mass spectrometers with extremely high sensitivity for isotopic and chemical analyses; a variety of x-ray microanalytical facilities on beam lines at the Advanced Photon Source, including microprobe x-ray fluorescence spectrometry; several types of mass spectrometers, including a multicollector ICP-source mass spectrometer in the Isotope Geochemistry Laboratory at the Field Museum which is used to study early solar system processes such as planet formation; ion and electron microprobes, electron microscopes, experimental petrology equipment, machine and electronics shops for building new laboratory and spaceflight instruments, and a wide array of computational facilities.

The CHARISMA instrument in ANL-MSD has produced a number of results relating to isotope distributions of trace elements in individual micron-sized stardust grains. These studies provide unique insights into nuclear astrophysics and the inner workings of stars. Our results have revealed details of nuclear processing and have pointed out the need for new nuclear physics experiments to measure certain key reaction rates. We have recently detected the remnants of extinct ^{99}Tc in stardust grains, closing the loop on a field that began with live Tc detection in stars more than 50 years ago. This work was published in *Science*, **303**, 649-652 (2004) and was the subject of a *Perspectives* article in the same issue which said "The discovery of extinct technetium in AGB stardust brings the science of nucleosynthesis full circle."

Performers

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Andrew Davis (University of Chicago), Meenakshi Wadhwa (The Field Museum)

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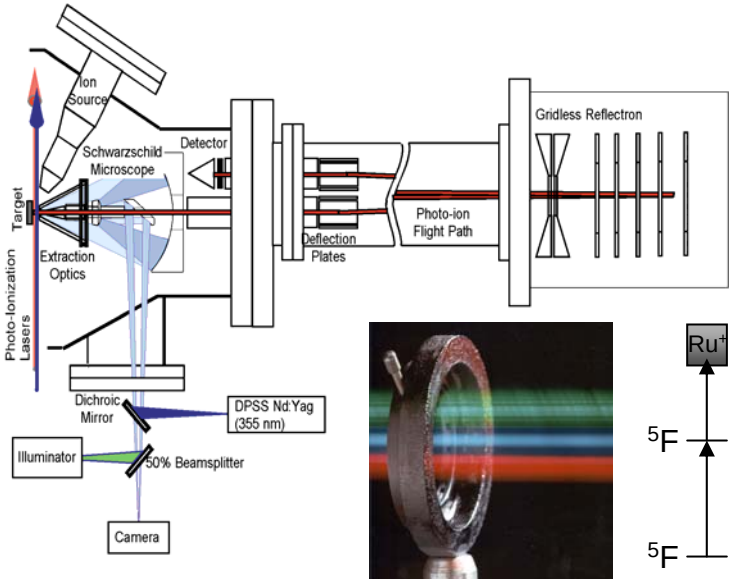
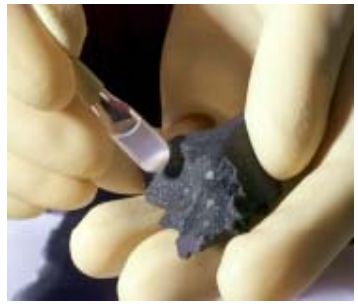
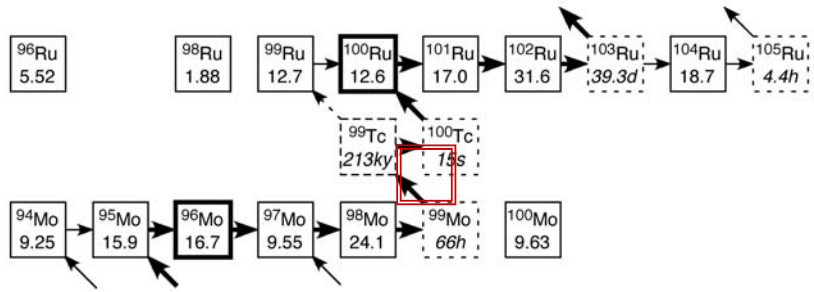


Resonant Ionization Mass Spectrometry on the CHARISMA and SARISA instruments at **Argonne National Laboratory** provides unique insight into the makeup of extraterrestrial materials.



University of Chicago scientists discovered stardust in meteorites from the **Field Museum**.



Stardust isotope data coupled with stellar modeling and nucleosynthesis theory provides an understanding of the origins of the elements, such as the now-extinct ^{99}Tc.

Extinct Technetium in Silicon Carbide Stardust Grains: Implications for Stellar Nucleosynthesis
Savina, M., Davis, A. M., Tripa, C. E., Pellin, M., Lewis, R. S., Amari, S. and Gallino, R., *Science*, **303**, 649-652, 2004

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